

Autonomous Mobile Vehicle based on RFID Technology using an ARM7 Microcontroller

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Abstract— Radio Frequency Identification (RFID) system is looked upon as one of the top ten important technologies in the 20th century. Industrial automation application is one of the key issues in developing RFID. Therefore, this paper designs and implements a RFID-based autonomous mobile vehicle for more extensively application of RFID systems. The microcontroller LPC2148 is used to control the autonomous mobile vehicle and to communicate with RFID reader. By storing the moving control commands such as turn right, turn left, speed up and speed down etc. into the RFID tags beforehand and sticking the tags on the tracks, the autonomous mobile vehicle can then read the moving control commands from the tags and accomplish the proper actions. Due to the convenience and non-contact characteristic of RFID systems, the proposed mobile vehicle has great potential to be used for industrial automation, goods transportation, data transmission, and unmanned medical nursing etc. in the future. Experimental results demonstrate the validity of the proposed mobile vehicle.

Keywords— Radio Frequency Identification, RFID Reader, RFID Tag, Industrial Automation, ARM 7 MCU.

I. INTRODUCTION

The project aims at making the robot to move in a particular Defined direction, connected at the Controller, specified by the user at the RFID Tag. The project uses the RFID technology and Embedded Systems to design this application. The main objective of this project is to design a system that continuously checks for the RFID and changes the direction of the ROBOT accordingly.

This project is a device that collects data from the RFID section, codes the data into a format that can be understood by the controlling section. This receiving section controls the direction of the robot as per the command received from the RFID section. The objective of the project is to develop a microcontroller based control system. It consists of a RF Reader and Tag, microcontroller and the robotic arrangement.

The software application and the hardware implementation help the microcontroller read the data From RFID Tag and accordingly change the direction of the robot. The measure of efficiency is based on how fast the microcontroller can read the data, detect the signal received and change the direction of the robot. The system is totally designed using RFID and embedded systems technology. The performance of the design is maintained by controlling unit.

II. HARDWARE ARCHITECTURE

Fig. 1 shows the hardware architecture of the proposed autonomous mobile vehicle. The proposed vehicle can be divided into four parts.

- 1) The RFID tags stuck on the tracks;
- 2) The RFID reader used to communicate with RFID tags and transmit the moving control commands to Micro Controllable Unit, (MCU) module;
- 3) The MCU module used to receive the moving control commands from RFID reader and control the mobile vehicle; and
- 4) The mobile vehicle.

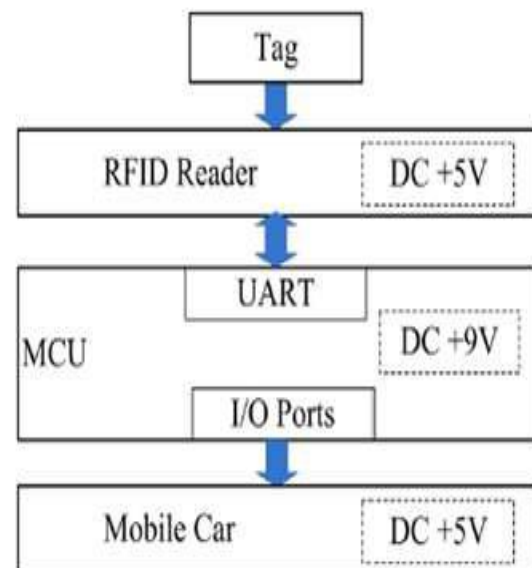


Fig.1. Hardware Architecture for the proposed Vehicle

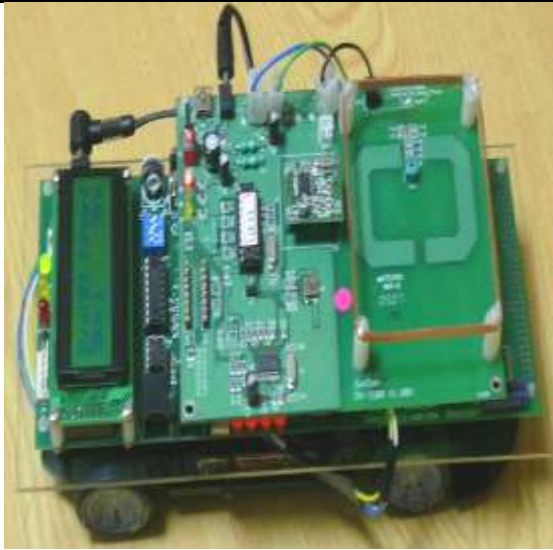


Fig.2. Physical Architecture of the proposed Vehicle

Firm Ware for the Proposed Vehicle:

Due to limited budget, a simple and cheap motor is used in the proposed autonomous mobile vehicle. Of course, a high precise motor can also be integrated into the proposed vehicle to achieve more advanced and accurate control without modifying the architecture represented in this paper. Two motors are used in the proposed vehicle for direction and speed controls, respectively. Fig. 2 shows the driving circuit used in the motor control of the proposed autonomous mobile vehicle. From Fig. 2, it can be seen that two control signal generated by MCU are used to control one motor. For direction control, the control signals 1 and 2 are used to control the vehicle to turn left and turn right, respectively. For speed control, the control signals 3 and 4 (not shown in Fig. 2) are used to control the vehicle to move forward or speed up and move backward or speed down, respectively.

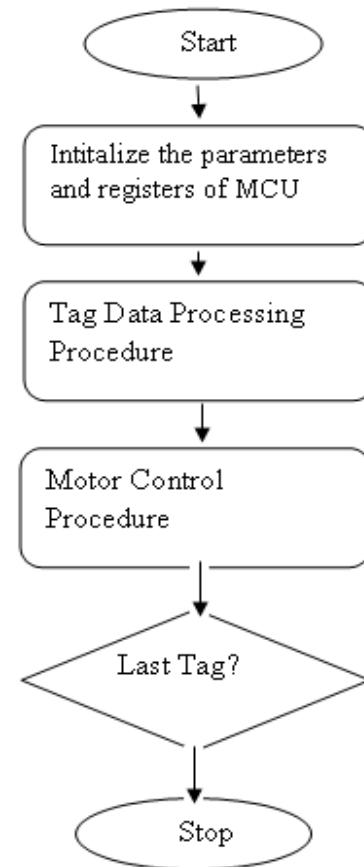


Fig.3. Flowchart for the programming of the proposed vehicle

The firmware programmed in LPC2148 is designed to communicate with RFID tags and control the motors according the commands received from the tags. Therefore, the main firmware programmed as shown in Fig. 3 can be divided into two parts; tag data processing procedure and motor control procedure. The flowchart of tag data processing procedure is shown in Fig. 4. From Fig. 4, it can be clearly observed that MCU will transmit the request command to tags and then received control commands from tags periodically. The control commands should include the moving forward/backward, direction and speed etc. If the commands have been received completely, the commands will be further transmitted from RFID reader to MCU.

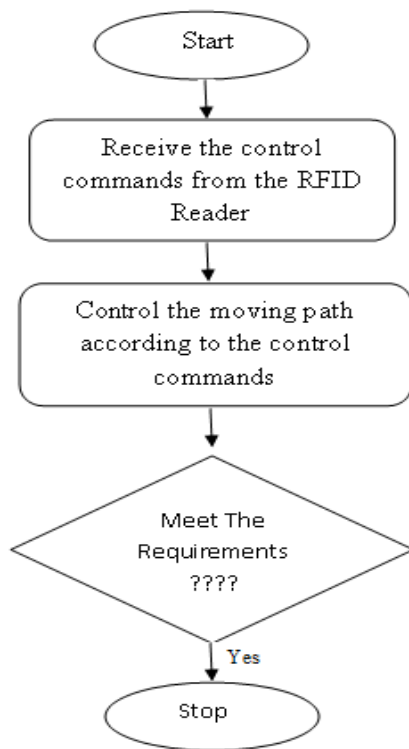


Fig.4. Flowchart of Tag data Processing Procedure

Fig. 5 shows the flowchart of motor control procedure. From Fig. 5, it can be seen that after the MCU received the control commands from RFID reader, the MCU will calculate and then send the PWM signals through the control signals 1-4 to motors; and therefore, the vehicle will move according to the signals. A PI-based feedback control method is used in this paper to make sure that the required moving path can be achieved.

The RFID tags in use possess use possess (64 pages x 4 bytes) memory capacity. The tag used only employs 3 bytes to control moving path of one vehicle. . Of course, more accurate control commands can also be planned; for example, more divisions for direction and speed control such as turn 10 deg. left with speed 10 cm/s etc. can be planned and stored in tags to control the vehicle.

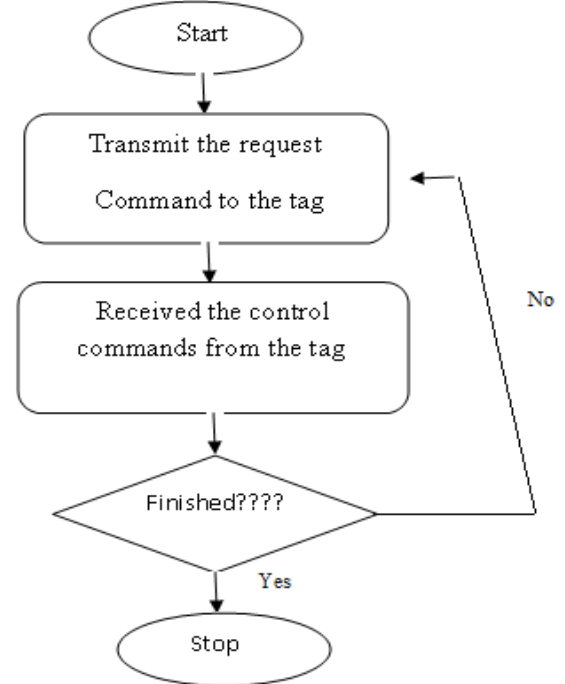


Fig.5. Flowchart of Motor Control Procedure

III. EXPERIMENTAL RESULTS

A RFID-based autonomous mobile vehicle was designed and implemented in this paper. Several moving paths can be planned as said earlier and can be tested; however, only four cases are taken into consideration while testing originally. Four tags are used to control the vehicle with respect to the three cases, respectively. All test cases showed that the proposed vehicle can move according to the control commands received from the tags. Therefore the validity of the proposed system can be demonstrated.

IV. CONCLUSION

A RFID-based autonomous mobile vehicle was successfully designed and implemented in this paper. By writing the moving control commands into the RFID tags beforehand and sticking the tags on the tracks, the autonomous mobile vehicle can then read the moving commands from tags and accomplish the proper actions. Experimental results demonstrated the validity of the proposed system. Some more comprehensive and advanced control methods and their corresponding control commands can also be designed and stored in tags and then used to control the vehicle accurately, the research will be investigated in the future.

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